COURSE SYLLABUS

# Pathway for Engineering, 30 credits

*Pathway for Engineering, 30 högskolepoäng*

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|---|---|---|---|
| **Course Code:** | PENX07 | **Education Cycle:** | Basic level |
| **Confirmed by:** | Dean Nov 22, 2016 | **Disciplinary domain:** | Natural sciences (50%) and technology (50%) |
| **Valid From:** | Jan 1, 2017 | **Subject group:** | |
| **Version:** | 1 | **Specialised in:** | GXX |
| **Reg number:** | JUE 2017/396-313 | | |

## Intended Learning Outcomes (ILO)

On successful completion of the Pathway for Engineering course students will be able to:

Knowledge and understanding

1. display knowledge of elementary functions, including their basic properties
2. display knowledge of the concept of geometric sum and linear optimization
3. display knowledge of numerical methods to calculate integrals
4. display knowledge of the structure of the atom and the chemical bonding
5. demonstrate comprehension of some elementary acid-base and redox reactions and also of some of their applications
6. demonstrate comprehension of energy changes in chemical reactions
7. demonstrate knowledge of physical quantities and units

Skills and abilities

8. demonstrate ability to transform and simplify algebraic and trigonometric expressions
9. demonstrate skills of solving equations of various sorts
10. demonstrate skills of calculating derivatives and basic integrals for elementary functions
11. demonstrate ability to use derivatives in order to analyze the properties of a given function and to methodically solve optimization problems
12. demonstrate skills of using trigonometric formulas to solve problems for triangles
13. demonstrate skills of using integrals to solve geometrical problems
14. demonstrate ability to perform simple pH and stoichiometry calculations and also to interpret chemical formulas and the hazard classification and labelling of chemicals
15. demonstrate skills in using experimental methods and interpret the results in both physics and chemistry laboratories
16. demonstrate skills in solving motion problems in one dimension, using Newton's laws and conservation of energy
17. demonstrate skills in using the concepts of momentum, impulse, pressure, heat, temperature, electrostatic forces and fields in calculations
18. demonstrate skills in calculating current, voltage, potential and resistance in DC circuits

19. demonstrate skills in applying the special theory of relativity
20. demonstrate skills to interpret and carry out basic calculations in nuclear physics

## Contents

The Pathway for Engineering course is a preparatory course for students who do not meet the level of required Mathematics, Physics and Chemistry for University studies in Sweden.

The purpose of the course is to provide Mathematics, Physics and Chemistry education corresponding to the Swedish upper secondary school courses Mathematics 3b and 3c, Physics 1 and Chemistry 1. The purpose is also to prepare students for Higher Education in Sweden by giving support in adjusting to the demands, challenges and expectations of Swedish Higher Education.

The course consists of four sub-courses; Pathway Mathematics 1 Pathway Mathematics 2, Pathway Chemistry and Pathway Physics. Knowledge will be gained through lectures, assignments, laboratory exercises and mentoring sessions. Weekly tasks will be set and marked to track progress.

### Sub-course: Pathway Mathematics 1

The course includes the following elements:
- Basic algebra
- Geometric sums
- Studies of polynomial, power and exponential functions
- Derivatives, differentiation rules for the functions mentioned above
- Applications using the derivative to solve optimization problems
- Integrals

### Sub-course: Pathway Mathematics 2

The course includes the following elements:
- Basic algebra
- Elementary function theory
- Trigonometric formulas and identities
- Derivatives, differentiation rules
- Integrals, applications using integrals to solve geometrical problems

### Sub-course: Pathway Chemistry

The course includes some basic chemical concepts about the structure and the functions of the matter, the transformations of the substances within chemical reactions and also the importance of Chemistry for people and societies.
The course includes the following elements:
- The risks at work in the laboratory together with labelling and handling of chemicals
- Matter and chemical bonding
- Chemical formulas and calculations
- Energy changings at chemical reactions
- Acids and bases

- Redox reactions and electrochemistry

### Sub-course: Pathway Physics

The course introduces the basic physics and the science of working with experiments, analysis and interpretation of measurements using models. In addition, the course will provide familiarity with the use of mathematical concepts in physics and algebraic handling of formulas and expressions.
The course includes the following topics:
- Motion: speed, acceleration, laws of motion with constant acceleration
- Forces: Newton's laws of gravity, normal force, gravitational force, Hooke's Law, the friction force, inclined plane.
- Energy and work: kinetic energy, potential energy, power and efficiency, the energy principle
- Pressure: density, pressure in liquids and gases, Archimedes' law and gas laws
- Heat and temperature: heating and cooling, phase transitions and calorimetry
- Electricity: electric charges and forces and electric fields, electric current, voltage and potential, resistance and resistivity, electrical energy and power
- DC circuits: series and parallel connections of resistors and batteries
- Impulse and momentum: conservation of momentum, elastic and inelastic collisions
- Nuclear physics: nuclear reactions, activity and half-life, radioactive radiation
- Principle of relativity: light speed, time dilation and length contraction, relativistic energy.

## Type of instruction

Lectures, laboratory exercises and mentoring sessions.

The teaching is conducted in English.

## Prerequisites

High School Diploma and English language skills corresponding to:
IELTS 6.5 or the equivalent
Mathematics 2a, 2b, 2c or the equivalent

## Examination and grades

The course is graded Fail (U) or Pass (G).

The examination consists of written assignments, laboratory experiments and written exams. Active participation throughout the course is required.

The final grade of the course is issued only when all course units have been passed.

Registration of examination:

| Name of the Test | Value | Grading |
|---|---|---|
| Written Examination Pathway Mathematics 1[1] | 7.5 credits | U/G |
| Written Examination Pathway Mathematics 2[2] | 7.5 credits | U/G |
| Written Examination Pathway Chemistry[3] | 4 credits | U/G |

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| Laborations and Assignment Pathway Chemistry[4] | 2 credits | U/G |
| Written Examination Pathway Physics[5] | 6 credits | U/G |
| Laborations and Assigment Pathway Physics[6] | 3 credits | U/G |

[1] ILO 1; ILO 2; ILO 8; ILO 9; ILO 10; ILO 11; ILO 12

[2] ILO 1; ILO 3; ILO 8; ILO 9; ILO 10; ILO 13

[3] ILO 4; ILO 5; ILO 6; ILO 14;

[4] ILO 5; ILO 14; ILO 15;

[5] ILO7; ILO16; ILO 17; ILO 18; ILO 19; ILO 20

[6] ILO 7; ILO 15

## Other information

### Title of qualification

The course gives you a Pathway for Engineering Course Certificate demonstrating skills equivalent to the Swedish upper secondary school courses Mathematics 3b and 3c, Physics 1 and Chemistry 1.

### Qualification Requirements

To obtain the Pathway Certificate the student shall complete the course requirements of 30 credits where 7.5 credits constitute Pathway Mathematics 1, 7.5 credits constitute Pathway Mathematics 2, 6 credits constitute Pathway Chemistry and 9 credits constitute Pathway Physics. Active participation required in lectures, assignments, laboratory exercises and mentoring sessions is compulsory in order to meet the requirements of the course.

### Continuation Requirements

Students who successfully complete the Pathway for Engineering, 30 credits may enter into, if preselected and eligibility assessed, the Bachelor programme Sustainable Supply Chain Management at JU without any further testing.

## Course literature

Handouts provided by JU.